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IS 8221 (1976): Code of practice for corrosion prevention of metals and metal components in packages [MTD 24: Corrosion Protection]



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Indian Standard

CODE OF PRACTICE FOR CORROSION PREVENTION OF METALS AND METAL COMPONENTS IN PACKAGES

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**BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI-110002**

Indian Standard

CODE OF PRACTICE FOR CORROSION PREVENTION OF METALS AND METAL COMPONENTS IN PACKAGES

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Indian Standard

CODE OF PRACTICE FOR CORROSION PREVENTION OF METALS AND METAL COMPONENTS IN PACKAGES

0. FOREWORD

0.1 This Indian Standard was adopted by the Indian Standards Institution on 29 September 1976, after the draft finalized by the Corrosion Protection Sectional Committee had been approved by the Structural and Metals Division Council.

0.2 Metallic parts enclosed in packages often corrode during transit and storage. Moisture and reactive vapours given off by packaging materials, adhesives, paints, varnishes and similar materials readily reach concentration high enough to permit reaction with metal surfaces causing corrosion.

0.3 Unless a proper selection of the packaging materials is made and other protective measures are adopted, corrosion will occur during transit and storage of metals and metallic components. This code deals with the methods for prevention of corrosion inside packages.

0.4 In the preparation of this standard assistance has been derived from the following:

IS : 6049-1971 Code of practice for application of temporary corrosion preventives

BS 1133 : Section 6 : 1966 Packaging code, Section 6 : Temporary protection of metal surfaces against corrosion (during transport and storage)

DEF-1234 General requirements for packaging supplies for the services. Ministry of Defence, UK

0.4.1 Assistance has also been taken from published information on the work carried out at Defence Research Laboratory (Materials), Kanpur.

0.5 In reporting the result of a test or analysis made in accordance with this standard, if the final value, observed or calculated, is to be rounded off, it shall be done in accordance with IS : 2-1960*.

*Rules for rounding off numerical values (revised).

1. SCOPE

1.1 This standard describes the various factors responsible for causing corrosion of metals and metallic components inside packages and measures that may be adopted for its prevention.

SECTION I GENERAL

2. FACTORS WHICH PROMOTE CORROSION

2.1 Moisture — Under normal conditions severe corrosion of metals occurs when the relative humidity of the atmosphere is over the critical limit, that is, 70 percent RH. Use of unseasoned timber containing a large proportion of water, which may be even more than 100 percent of its dry weight, and partly seasoned timber gives rise to various problems when metallic equipments are packed in these wooden boxes or crates due to release of water vapour (moisture) and organic acid vapours from wood (*see* 2.2). In tropical storage, increased humidity and high temperatures accelerate the rate of corrosion. Properly dried wood (moisture content 12 percent, *Max*) does not contribute to or promote corrosion. But due to hygroscopic nature of wood, moisture pick-up takes place when wooden boxes are moved from a place of lower humidity to a place of higher humidity. Iron and steel start corroding when RH goes beyond 70 percent. At 50 percent to 60 percent RH (corresponding to 10 to 11 percent moisture in wood) in the absence of pollutants corrosion does not take place at ordinary temperature. It has been found that in any confined space, such as in a wooden box, 80 percent relative humidity may occur at 15°C, 25°C, 40°C and 70°C if wood has 20 percent, 18 percent, 16 percent and 12 to 14 percent moisture content respectively. These conditions cause severe corrosion of metals particularly in tropics. The humidity also increases if inadequately dried cushioning materials or other water absorbent materials are used inside packages.

2.2 Corrosive Vapours — Corrosive vapours are emitted by unseasoned timber and certain species of timber even in seasoned state, plastics, paints, varnishes and insulating compositions. The increased temperatures in tropical climates raise vapour pressure of volatile materials, increase their rates of diffusion through pores in barrier wraps and subsequently into the packages and thus, ultimately increase the rate of corrosion.

2.2.1 Corrosive Vapours from Timber — Large quantities of free acetic acid are liberated by unseasoned timber. Certain species of timber, such as kail, chir, deodar, fir, sal, mulberry and gurjan, although well seasoned, liberate organic acid vapours such as formic and acetic acid vapours under hot and humid conditions. In an enclosed space inside packages accumulation of acid vapours takes place, which in conjunction with moisture, causes severe corrosion to packed metallic items. It may not be possible to make any arbitrary classification of wood as safe and dangerous, because it would entirely depend upon the environmental conditions to which they are subjected and relative susceptibility of metals towards different species of timber. However, timbers which contain resin canals or gum ducts are more corrosive irrespective of whether they are porous or non-porous, for example, kail, deodar, fir, sal, mulberry, gurjan and chir. Timbers without resin canals or gum ducts are less corrosive, for example, sisso, mango, poon, kokko, chikrassy, bijasal, teak and semul. A strongly acid wood (pH less than 4.0) is potentially dangerous whereas a less acidic or neutral wood (pH more than 5.0) is likely to be relatively safe.

2.2.2 Corrosive Vapours from Other Materials — Corrosive vapours are liberated from incorrectly cured plastics, such as phenolformaldehyde, insulating tapes, paints, varnishes, glues, adhesives, etc. Propionic and butyric acids liberated from paints are highly volatile and corrosive. Vapour phase inhibitors which are used for prevention of corrosion of ferrous metals may cause corrosion of non-ferrous metals.

2.3 Corrosive Action of Electrolytes — Paper wraps, electrical insulating tapes, cartons, cushioning and other packaging materials generally contain electrolytes (salts) as impurities. Water soluble chlorides and water soluble sulphates present in these induce severe corrosion unless their concentrations are kept below permissible limits (0.02 percent for chlorides and 0.12 percent for sulphates). Coir fibre used as cushioning material should not contain more than 0.02 percent chlorides expressed as water soluble sodium chloride. Although natural coir does not contain any chlorides, it may pick up contamination while it is being processed by retting in sea water, as is common in commercial practice. It remains contaminated unless it is subsequently washed with sweet water. Chloride contaminated coir readily absorbs moisture and, if such coir is used for packaging of metallic stores, it may promote corrosion.

SECTION II PREVENTIVE METHODS

3. SURFACE PREPARATION

3.1 Surface preparation is the most important precondition for adoption of any method of corrosion prevention, as application of even the best preservative loses much of its value unless the metallic surface is thoroughly cleaned of all impurities. One or more of the various contaminants such as: (a) dirt and dust; (b) greases and oils; (c) sweat residues from handling; (d) metallic residues (swarf) from machining; (e) scale, rust and other corrosion products; and (f) moisture; are likely to be present on the surface. These shall be removed before application of any corrosion preventive.

3.2 For methods of degreasing, derusting and drying of stores, reference may be made to IS : 6049-1971*.

3.3 After cleaning, the items should be given appropriate protective treatment.

4. TEMPORARY CORROSION PREVENTIVES

4.1 These materials afford protection from corrosion to metal surfaces during transit and storage. The advantages of using these preservatives are that they are easily removable and the articles may be taken into use without much difficulty. In some cases even the removal of the preservative may not be necessary. These may be classified into the following groups according to the type of film formed.

4.1.1 Group I — fluid hard film, solvent deposited (see IS : 1153-1957†). On application this leaves a thin hard film which does not get easily removed by abrasion, but may be removed when required by means of petroleum solvents, such as white spirit and kerosene. Under indoor conditions protection given by this preservative varies from one to two years.

4.1.2 Group II (a) — thick soft film, for example, greases (see IS : 507-1970‡, IS:958-1958§ and IS:6048-1970||), mineral jelly and beeswax mixture (90 : 10), and lead stearate and castor oil grease (for metal components containing rubber). On application these form a thick waxy or greasy film. Except for grease all others are to be melted by controlled heat not exceeding 100°C for easy application. The treated stores when properly wrapped and kept indoors remain protected against corrosion for about two years.

*Code of practice for application of temporary corrosion preventives.

†Specification for temporary corrosion preventive, fluid, hard film, solvent deposited.

‡Specification for general purpose grease (first revision).

§Specification for temporary corrosion preventive grease, soft film, cold application.

||Specification for temporary corrosion preventive, soft film, hot-dipping type.

4.1.3 Group II (b) — thin soft film, for example, soft film solvent deposited (see IS : 1674-1960*) and for soft film solvent deposited, water displacing (see IS : 1154-1957†). On application these leave a thin soft film which is thicker than oil film. Under indoor conditions protection given by the former varies from six months to one year and by the latter for a few months only.

4.1.4 Group III — oil type film, inhibited or uninhibited mineral oil depending on the duration of protection required. Under indoor conditions this gives a protection for a few months only.

4.2 The methods of application of the above preservatives and some examples of stores for which these are suitable are given in Table 1. Reference should also be made to IS : 6049-1971‡.

4.3 Copper, brass, aluminium, zinc, etc, due to their intrinsic nature possess natural protective coating and, therefore, do not require any additional protective coating under normal conditions of exposure. If, however, these are exposed to aggressive conditions requiring them to be protected, Group I and Group II (a) preservatives mentioned in 4.1 may be considered for use.

5. PREVENTION OF CORROSION OF FERROUS ITEMS BY USE OF VOLATILE CORROSION INHIBITORS (VCI)

5.1 These are also known as 'vapour phase inhibitors' (VPI). These are volatile chemicals, the vapours of which in an enclosed system protect ferrous articles against corrosion even when the relative humidity exceeds the critical limit. These are easy to apply and may be easily removed when required or need not be removed at all. These are available in a powder form or coated paper (see IS : 5730-1970§ and IS : 6263-1972||). The powder may be sprinkled or be placed in perforated containers at suitable places so that the inhibitor vapour may reach even the inaccessible parts/surfaces. Polyethylene coated VCI paper may also be used to retain the effect for a long period (two to three years). The articles may be wrapped with the VCI/VPI coated paper and suitably sealed by adhesive tape or wax dipped to retain the vapour for long period which may go up to three to four years. Before using these chemicals, it shall be ensured that the parts are scrupulously cleaned from all impurities. The present VCI or VPI may be used only for ferrous articles. Adverse effects on some non-ferrous metals should be taken into account in the application on VCI or VPI.

*Specification for temporary corrosion preventive, fluid, soft film, solvent deposited.

†Specification for temporary corrosion preventive, fluid, soft film, solvent deposited, water displacing.

‡Code of practice for application of temporary corrosion preventives.

§Specification for volatile corrosion inhibitor powder.

||Specification for volatile corrosion inhibitor (VCI) treated paper.

6. PROTECTIVE/COATING OF NON-METALLIC NATURE

6.1 Paint Coating — Paints afford very good protection which is next to metallic coatings. Wherever permissible the surface should be protected by application of a suitable paint. Before application of paint the surface should be properly prepared.

6.2 Strippable Coatings — Basically these contain ethyl cellulose or similar plastic compound with some lubricating oil (*see* IS : 6050-1971*). For application these are melted in a thermostatically controlled electric bath at a temperature recommended by the manufacturers. Articles cleaned from all impurities are given a dip in the molten material and taken out slowly without giving a jerk so as to leave a uniform coating on the surface. On cooling a plastic coating sets on the surface and gives protection against corrosion and abrasion for about two to three years. The great advantage of using these materials is that the coating may be easily peeled off from the surface when not required and the scraped film may be melted and reused. For satisfactory protection it shall be ensured that the article has been scrupulously cleaned from all impurities before giving the plastic coating.

7. PREVENTION OF CORROSION BY CONTROL OF RELATIVE HUMIDITY

7.1 Corrosion to a very great extent may be prevented by reducing moisture content inside packages by use of: (a) well-seasoned timber, (b) dry cushioning material, and (c) by use of desiccating material. Wherever possible, especially when the store has not been or may not be protected with any other material, a desiccating material such as silica gel (*see* IS : 3401-1970†) should be used inside packages. The aim is to keep relative humidity less than 50 percent. The desiccant used would be rendered ineffective unless the packing is immediately made airtight and well sealed as recommended in 9.1 (Method II).

7.2 Before use it should be ensured that the desiccant is in active condition. The condition of silica gel may be ascertained with the help of an indicator (namely, cobalt chloride). When active, the silica gel granules stained with cobalt chloride appear blue and as it absorbs moisture the colour gradually changes to pink indicating that it has become spent or exhausted. As soon as the pink colour is noticed it should be replaced by fresh silica gel. The exhausted silica gel may be reused after reactivating by heating in an oven (*see* Appendix A for method of reactivation).

*Specification for temporary corrosion preventives, strippable, hot-dipping type.

†Specification for silica gel (*first revision*).

TABLE 1 TEMPORARY CORROSION PREVENTIVES AND THEIR USES

(Clauses 4.2 and 9.1)

SL No.	TYPE OF PROTECTIVE FILM FORMED	NAME OF PRESERVATIVE	METHOD OF APPLICATION	REMOVAL	SUITABLE FOR	NOT SUITABLE FOR	WRAPPING
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
i)	Group I Thin and hard film	Fluid hard film solvent deposited (IS : 1153-1957*)	Dip, brush, spray at room temperature	Complete removal may be necessary. May be removed with the help of kerosene or white spirit preferably aided by brushing	Items which are not plated or highly finished or do not have moving parts, hand tools, etc	Inaccessible interior surfaces; parts with parallel surfaces coming into contact with each other; parts containing rubber	Wrapping should be done after the film has dried. Individual wrapping is not essential except for sharp edges, pointed ends or delicate parts
ii)	Group II(a) Thick soft film	a) Soft film, hot-dip type (IS: 6048-1970†) b) Mineral jelly and beeswax mixture (90 : 10) c) Grease d) Lead stearate and castor oil grease	(a), (b) and (d) hot-dip in molten material or brush; (c) brushed or smeared. Should not be heated nor diluted for application	Complete removal not essential. Removal by solvent like kerosene. Solvent immersion not to be used for grease filled items or for items containing rubber. Removal also by dipping in hot mineral oil	(a) and (b) for stores having moving parts, plated items, threaded parts, ball and roller bearings, plain bearings inserters, pistons, oil seals (without rubber attachment), (c) as in (a) and (b) above when dipping is not possible, (d) used for metal components containing rubber	(a), (b) and (c) not suitable for parts containing rubber; (a) and (b) not suitable for assemblies containing light working parts, assemblies containing leather washers if a dip in preservative for more than one minute is necessary	Treated stores should be wrapped with grease resisting paper, or oiled paper after these have cooled down and the preservative coating has set
iii)	Group II(b) Thin soft film	a) Fluid, soft film, solvent deposited (IS : 1674-1960‡) b) Fluid, soft film, solvent deposited, water displacing (IS : 1154-1957§)	(a) and (b) dip, brush, spray or flush	(a) and (b) not necessary	(a) Plated items, delicate parts, sharp and pointed instruments, surgical instruments, gives protection for a short duration. Mainly used to remove water from wet surfaces specially of intricate mechanism and to leave a protective film till a more appropriate preservative is applied	(a) and (b) for parts containing rubber	Treated stores should be wrapped with paper grease resisting or oiled paper
iv)	Group III Oil type film	a) Oil engine preservative SAE 30 b) Neat or inhibited mineral oil having pour point below -20°C	(a) and (b) dip, flow or flushing	(a) and (b) not necessary	(a) Suitable when ambient temperature is above 0°C, and (b) when ambient temperature is below 0°C but not below -20°C. Instruments and very small bolts, nuts, washers, internal surfaces of containers	Exposed parts or assemblies	In paper, grease resisting or oiled paper except for containers internally treated

*Specification for temporary corrosion preventive, fluid, hard film, solvent deposited.

†Specification for temporary corrosion preventive, soft film, hot-dipping type.

‡Specification for temporary corrosion preventive, fluid, soft film, solvent deposited.

§Specification for temporary corrosion preventive, fluid, soft film, solvent deposited, water displacing.

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7.3 To simplify both handling and calculation, desiccants are supplied commercially in sacklets or canisters containing definite units of basic desiccant. One unit of a desiccant is defined as a material that will absorb 27 percent of its dry weight of moisture when placed in an atmosphere kept at 50 percent RH at 25°C. Thus 226.5 g of a desiccant having half this absorptive capacity will constitute a 113.25 g quantity of basic desiccant. For practical purpose the following formulae are used:

$$\text{For tropical storage in flexible barrier packs } w = 80 a RM + \frac{d}{2}$$

$$\text{For hermetically sealed packages } w = 16.25 \frac{v}{100} + \frac{d}{2}$$

where

w = mass in g of basic desiccant;

a = area of the water vapour barrier in m^2 ;

R = water vapour transmission rate of the barrier in g/m^2 in 24 hours measured at 90 percent RH differential and 38°C;

M = maximum time;

d = mass in g of hygroscopic blocking, cushioning, packing and similar materials inside the barrier; and

v = volume in dm^3 of air inside the barrier.

8. PACKAGING

8.1 Packaging is an integral part of preservation. It not only enhances the life of preservative, but also gives protection against climatic and physical hazards such as impacts, vibration, drops and compression. The various stages of packaging after cleaning and preservation are inner wrap or primary packaging, unit and intermediate containers, cushioning, outer or bulk containers, strapping identification and marking.

8.2 While selecting packaging materials the following points shall be taken into consideration.

8.2.1 Wrapping paper shall be compatible with type of preservative applied. For example stores treated with hard film type preservative should be wrapped with waxed or kraft paper and those treated with soft film type preservative with grease-resisting paper, oiled paper, polyethylene film or foil laminate.

8.2.2 Wrapping and cushioning materials and cartons should be dry and should have chloride and sulphate contents below 0.02 percent and 0.12 percent respectively.

8.2.3 In selecting timber for packing cases preference should be given to timbers which induce low to medium corrosion rather than those inducing medium to high corrosion. Sisso, mango, poon, kokko, chikrassy, bijasal and simul fall in the first group and kail, chir, mulberry and gurjan in the second group.

8.2.3.1 The moisture content of timber shall not exceed 12 percent (see IS : 6662-1972*, IS : 1503-1973† and IS : 1141-1958‡). The pH value of the water extract of timber shall be not less than 5 when determined in accordance with the method given in Appendix B.

8.3 Use of Waterproof Paper or Polyethylene Liner Inside Packing Cases — An inner lining of bituminized paper or polyethylene (15 micron) is very effective in preventing ingress of moisture and corrosive vapours into the wooden cases. This prevents corrosion of packed items.

8.4 Treatment of Felt Pad/Linings Inside Packing Cases with Corrosion Inhibitors — Corrosion often occurs in steel surfaces which remain in direct contact with felt pad/lining used inside packing boxes or containers. This may be prevented by immersion in aqueous solution of either 10 percent sodium benzoate or 10 percent urea and sodium nitrite mixture (1 : 1) for 5 minutes followed by drying.

9. CLASSIFICATION OF PRIMARY PACKAGING METHODS

9.1 The inner wraps or primary packaging methods are classified in the following categories depending on climatic considerations.

9.1.1 Method O — This method is applicable for those items which by nature of their construction and composition are immune to the damaging effects of water, water-vapour, fumes, atmospheric gases and fungus growth. Such stores do not require to be treated with a temporary corrosion preventive or waterproof barrier wrapping.

9.1.2 Method I — In this method the item is coated with an appropriate temporary corrosion preventive (see Table 1) and wrapped with waxed, kraft paper, grease resisting paper or foil laminate.

9.1.3 Method IA — In this method the item, depending on its nature, may or may not be treated with a temporary corrosion preventive, but it shall be enclosed in a water-vapourproof barrier. The item may be packed in carton and dip-sealed in dip sealing compound or sealed in metallic container or heat-sealable foil bags.

*Specification for timber species suitable for wooden packaging.

†Specification for wooden packing cases (first revision).

‡Code of practice for seasoning of timber (first revision).

9.1.4 Method IC — In this method the item may or may not be treated with a temporary corrosion preventive. It is packed in cardboard carton sealed with adhesive tape or heat-sealed in polyethylene-coated bag. The pack is waterproof but not water-vapourproof as in Method IA.

9.1.5 Method II — In this method the item is enclosed in a water-vapourproof barrier alongwith a desiccant and sealed. The barrier may be wax-coated carton or rigid box with a covering of polyethylene film or foil laminate bags or metal containers. The relative humidity inside the enclosure is maintained at 20 percent by using a desiccant such as silica gel and should not be allowed to exceed 50 percent RH for a period of one and a half years to two years. The date of preservation shall be marked on the outer container. Also on the outer container the words '*Method II Pack — Do not open until required for use*' shall be written in large letters (see 7.3 for method of calculating the amount of desiccant required for a pack).

9.2 The methods of packaging given in 9.1.1 to 9.1.5 are sub-divided into the following methods.

9.2.1 Method O Packages

- 0/1 Supplies loose or in bundles.
- 0/2 Supplies loose or in bundles, with protection against physical damage by cushioning.
- 0/3 Small items wrapped separately or if appropriate, collectively, in the primary packaged quantity in waxed paper wrapping.

9.2.2 Method I Packages

- I/1 Metallic items protected with Group I protective solvent deposited thin hard film, wrapped and enclosed in primary container. Any excess space filled with waxed wrapping paper which has been crumpled by hand.
- I/2 Metallic items protected with Group II (a) protective thick soft film, for example, 90 : 10 mineral jelly and beeswax mixture, wrapped with grease-resisting paper or PVC film and flexible unsupported PVC sheeting and enclosed in a primary container.
- I/3 Metallic items protected with grease, wrapped and enclosed in primary container as in I/2.
- I/4 Metallic items protected with oil film type preservative, wrapped and enclosed in a primary container as in I/2.
- I/5 Metallic component containing rubber protected with castor oil lead stearate grease, wrapped and enclosed in primary container as is I/2 above.
- I/6 Metallic items protected with strippable coating and enclosed in a primary container.

9.2.3 Method IA Packages

- IA/1 Metallic items or assemblies protected with fluid soft film, solvent deposited, wrapped and packed in a carton or rigid box with a covering of foil, metal laminated sheet or polyethylene film.
- IA/2 Unpreserved items or assemblies packed in a carton or rigid box with a covering of foil, metal laminated sheet or polyethylene film.
- IA/3 Metallic items or assemblies protected with fluid soft film, solvent deposited, wrapped, packed in a carton or rigid box with a covering of waxed kraft paper and wax dipped.
- IA/4 Metallic items or assemblies protected with fluid soft film, solvent deposited, wrapped and packed in aluminium container.
- IA/5 Unpreserved items or assemblies wrapped, and packed in aluminium container.
- IA/6 Metallic items or assemblies protected with fluid soft film, solvent deposited, wrapped in waxed grease-resisting mouldable wrapping and wax coated.
- IA/7 Metallic items or assemblies protected with fluid soft film, solvent deposited, enclosed in a polyethylene film or metal foil laminated floating bag and packed in a primary container.
- IA/8 As in IA/7 above with no preservative to the surfaces.

9.2.4 Method IC Packages

- IC/1 Metallic items or assemblies protected with fluid soft film, solvent deposited, wrapped as in Method I/2 and enclosed in waterproof barrier incorporated inside the primary container.
- IC/2 Metallic items or assemblies protected with fluid soft film, solvent deposited, wrapped as in Method I/2 and enclosed in waterproof barrier applied outside the primary container. If polyethylene film is used for waterproof flexible barrier each primary package shall be overwrapped with kraft commercial quality paper. The ears shall be secured with gummed kraft paper tape.
- IC/3 Unpreserved items wrapped in waxed wrapping paper and enclosed in waterproof barrier.
- IC/4 Unpreserved items enclosed in polyethylene bag or envelope.

9.2.5 Method II Packages

- II/1 Items wrapped and packed with desiccant in a wrapped and wax coated carton or rigid box.

- II/2 Items wrapped and packed with desiccant in a carton or rigid box with a covering of polyethylene film.
- II/3 Items wrapped and packed with desiccant in a carton or rigid box with a covering of foil, metal laminated sheet.
- II/4 Items packed with desiccant in a cylindrical seamless aluminium container.
- II/5 Items packed with desiccant in a water-vapour resisting bag or envelope.
- II/6 Items packed with desiccant into a floating bag inside a container.
- II/7 Items packed with desiccant into an inner container with a covering of metal foil laminated sheet and packed into an outer container. The metal foil laminate shall be over-wrapped with imitation kraft paper (49 g/m^2) of commercial quality. The ears shall be secured with gummed kraft paper tape. The primary container shall be packed, if necessary, in an outer container.

APPENDIX A

(Clause 7.2)

REACTIVATION OF SILICA GEL

A-1. The action of silica gel is purely a physical one in that it absorbs moisture on its sensitive surface. These sensitive surfaces may of course be poisoned and lose activity if the silica gel is allowed to come in contact with oil, grease, petrol, etc, and in this case it is better to throw away the poisoned silica gel than to try to revive it.

A-2. Silica gel will be reactivated as and when necessary in order to perform the efficient desiccation of equipment.

A-3. Silica gel gives up absorbed moisture quite easily when heated to a temperature of 150 to 205°C and may be reactivated at this temperature after two to three hours, depending on the quantity to be reactivated and its age and condition.

A-4. Silica gel without an indicator is opal white in colour. When the indicator is incorporated, namely, stained with cobalt chloride solution, the granules are coloured. They will appear deep blue when the silica gel is fully active and turn pink when the silica gel is saturated with moisture. The silica gel with indicator contains five percent granules stained with the indicator and the rest white.

A-5. During the reactivation of silica gel it should be removed (where possible) from capsules, bags, containers or desiccators that it is packed in and spread on clean metal trays or tins in layers 1 to 2 cm deep. Thicker layers are not recommended as silica gel is a very poor conductor of heat, and in spite of heating during reactivation it is possible for layers of granules not to be fully reactivated.

A-6. After reactivation, and before the silica gel cools, it should be placed in clean airtight containers, tins or jars, that have tightly fitting lids, in order to prevent it picking up moisture from the atmosphere.

A-7. Powdered silica gel is of little use as a desiccant and should not be employed. Charred silica gel loses some of its efficiency as a drying agent and should be replaced as and when possible.

A-8. During heating the silica gel may occasionally pop and crackle and some of the granules may become discoloured. These signs are due to impurities in the silica gel and little notice should be taken of them.

A-9. The ideal method is an electric oven fitted with a temperature control in which layers of silica gel are placed on trays to a depth of 1 to 1.5 cm, the oven is then switched on and regulated to a temperature of 176°C. The gel is heated for a period of 2 to 3 h, the layers being stirred every half an hour until its moisture content has come down to 7 percent.

APPENDIX B

(Clause 8.2.3.1)

DETERMINATION OF pH VALUE OF TIMBER

B-1. Take a small sample of 2 g of powdered timber (the powdered timber having been obtained by means of filing with a carpenter's file and brought to constant mass by keeping it in an oven at 40°C), add 50 ml of boiling double distilled water and stir thoroughly. Allow to stand for half an hour, and bring down the temperature to room temperature by rapid cooling. Determine the pH value in accordance with 4.3 of IS : 5741-1970*.

*Methods for determination of pH.

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